TRAUMA ASSESSMENT OF INJURIES AND THEIR CONSEQUENCES IN ACCIDENTS WITH TWO-WHEELERS

by

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INTRODUCTION

This investigation of the degree of injury, the clinical progress and the long term consequences of accidents involving motorbicycles represents a valuable supplement and extension of the data obtained by analysis of traffic accidents at the accident site by the Hannover Accident Research Unit. Although in the medical documents the type of accident is mostly inaccurately documented and soft tissue damage is not comprehensively described the problematic nature of injury patterns can be estimated by considering the progress in typical cases.

MATERIAL AND METHODS

The data in this paper comes partly from records of 123 patients who were hospitalised in the Traumatology Department of the Hannover Medical School in 1978 and 1979 as a result of motorcycle accidents and partly from the files of the Hannover Accident Research Unit. In 59 cases additional information could be obtained from answers to specially designed questionnaires.

Table 1 Type of Vehicle

Type	n	%
Motor-Bicycle	22	17.9
Moped/Mokick	36	29.3
Motorcycle	65	52.8
Total	123	100.0

65 (52.8%) casualties were admitted primarily to our hospital, 58 (47.2%) were transferred from other hospitals. 109 (88.6%) were male, 14 (11.4%) female. 106 were injured as riders, mainly men (99/93.4%). Only 7 female drivers were found, 6 of them using motorbikes. One young lady met with an accident when she tried to handle her boyfriend's heavy 750 cm^3 motorcycle for the first time. 17 persons were injured as pillion-riders, with a high proportion of women (7/41%). The mean age of all patients was low: 22.1 (14-69) years.

Distribution of accident types is shown in Table 2.

Table 2 Types of Accident

Type	n	%
Collision with motor car	70	56.9
Collision with obstacle	7	5.7
Fall	22	17.9
Collision with truck	7	5.7
Collision with motorcycle	3	2.5
Collision with excavator	1	0.8
Unknown	13	10.5
Total	123	100.0

Every injury was rated according to the Abbreviated Injury Scale (AIS). The mean AIS was calculated for each body region and compaired with the results of SUREN (7), who had analysed 153 accidents of motorbicycles by recordings at the scene of accident. The most striking difference showed up in frequency and severity of injuries to the lower extremities. SUREN found 37% and AIS_m = 1.3 compaired with nearly 50% of all injuries and AIS_m = 2.2 in this study. On the other hand head injuries were seen less frequently but were nearly as severe (Table 3).

These differences are easily explained by the following characteristics of our survey:

1. Uninjured or slightly injured persons who do not need clinical treatment are not recorded.
2. Accidental deaths and deaths on arrival are not included.
3. Nearly half of the cases are transferred from other hospitals, predominantly for further treatment of severe leg injuries.

Table 3 Frequency of injuries to specific parts of the Body and average Severity

	n	%	AIS_m
Head	70	14.9	2.2
Neck	3	0.7	2.6
Thorax	15	3.3	2.5
Abdomen/ Pelvis	49	10.5	2.9
Upper extremities	98	20.9	2.0
Lower extremities	232	49.7	2.2
Total	467	100.0	2.2

82 (70.1%) of our patients had injuries of the lower extremities, of which 33 (28.3%) were combined with severe soft tissue damage. Ligamental knee instability was found alone or in combination with other injuries in 21 cases.

31 patients (25.2%) had head injuries, 16 of them only commotio with a short period of unconciousness. In 15 cases contusio cerebri or brain tissue damage could be proved by computer-tomography. 4 patients died of their severe brain traumas.

TRAUMA ASSESSMENT

For the traumatology surgeon the AIS (STATES,6) can only serve as a rough pattern to grade the severity of tissue damage. Considering age, constitution, accessory diseases and social environment the problems arising from accidental injury can be estimated according to the following aspects:

1. Threat to life
2. Long term treatment, complications, permanent damage

A good correlation between threat-to-life grades and the Injury Severity Score (ISS) has been proved regarding the age of the injured person (BAKER,1). It has been shown that mortality sharply rises at ISS $\geq$ 20.

Taking into consideration the injuries of 25 patients with ISS $\geq$ 20 the outstanding significance of cranio-cerebral trauma was shown.

Table 4 Injury Patterns with ISS>20

	survived	deceased	Total
Craniocerebral trauma	7	4	11
Abdominal and Pelvic trauma	5	1	6
Thorax trauma	1	1	2
Fractures of long bones	2		
- with amputation	2		
- with 3° burns	1		
- with paraplegia	1		6
Total	19	6	25

11 severe brain injuries were observed, 4 being fatal. Another case of death was caused by severe haemorrhage due to pelvis artery laceration. Amazingly, chest trauma is not as common among injured motorcyclists as it is among accident victims. (See also SUREN, 7). We found 2 cases, one patient died of septic pneumonia. Multiple fractures of long bones without additional injuries caused ISS 20 in 2 cases only, in 2 cases additional traumatic amputation had been observed, one more with extended 3rd degree burns and another one with paraplegia.

Long term treatment - Complications - Permanent damage: Problems of a different kind show up with injuries representing no threat-to-life but leading to protracted therapy, numerous complications and permanent impairment. The frequency of such problems is demonstrated by evaluation the reason for transfer of 58 patients who were sent to our traumatology centre for further treatment (Table 5).

The main cause for transfer were injuries of the lower extremity, predominantly when aggravated by severe soft tissue damage and infection. Nearly half of the cases refer to injuries of the lower leg.

To find out which injury pattern causes long term problems, our surviving 117 patients were split into 3 groups:

I : Injury pattern without lower extremity involvement

II : Injury pattern including lower extremities, however without severe soft tissue damage (closed and 1° open fractures, knee instability)

III: Involvement of the lower extremities and severe soft tissue damage (2° and 3° open fractures, closed fractures with severe contusion, vascular complications)

Table 5	Reason for transfer (n=58)			
Immediate transfer (0-1 day after trauma)	35		Delayed transfer (2 days-1.5 years after trauma)	23
I. Threat to life	13		I. Threat to life	2
a) Brain trauma	5		a) secondary splenic rupture	1
b) Polytrauma	3		b) septic abdominal wall phlegmon	1
c) Abdominal trauma	2			
d) Thorax trauma	2			
e) Shock	1			
II. Other problems	22		II. Other problems	21
1. Lower extremity	20		1. Lower extremity	19
a) Femur fracture with soft tissue damage	2		a) Femur fracture	1
b) Acetabular fracture	2		b) Infected non-union of femur	2
c) Tibia fracture	2		c) Tibia fracture	2
d) Tibia fracture with soft tissue damage	12	14	d) Delayed union after tibia fracture	1
e) Ligamental knee-instability	2		e) Soft tissue defect after tibia fracture	1
			f) Posttraumatic mal-alignment of tibia	2
			g) Infected non-union of tibia	6
			h) Ligamental knee-instability	4
2. Upper extremity	1		2. Upper extremity	2
3. Others	1		a) Forearm fracture	1
			b) Acromioclavicular joint rupture	1

The average number of operations and the average period of hospitalization were determined for the 3 different groups.

Table 6	Clinical Progress with different Injury patterns (see text)		
Group	n	Average number of operations	Average hospitalization time (weeks)
I	35	2.1	2.1
II	49	2.6	8.6
III	33	5.4	16.4
Total	117	3.2	9.0

It is clear that as a result of injury to lower extremities the average period of hospitalization is essentially protracted and the average number of operations and stay in hospital are doubled when there is an additional soft tissue injury.

This and the high average number of operations in group III may be explained by taking into consideration the extent of complications: Table 7:

Table 7 — Complications

	Immediate admissions			Delayed transfers		
Group	I	II	III	I	II	III
1. Infection						
a) Femur osteo-myelitis			1			2
b) tibia osteo-myelitis			1			13
c) Soft tissue infection of lower leg			2		1	2
d) Others		1				1
2. Delayed union and non-union without infection						
a) Femur						1
b) Tibia			1			1
c) Others				1		
3. Union with malalignement						
a) Tibia			?			3
4. Thrombosis	1	?			1	
5. Pulmonary embolism		?			1	

There is a special suspectibility of the lower leg to infection after skin and muscle contusion because of the weak soft tissue cover and the critical longitudinal blood supply of the tibia. It is obvious that long hospitalization and numerous operations in group III are mainly the result of bone infections. This condition needs firm stabilization of the fractured bone and multiple interventions to cure the soft tissue defects.

It has to be mentioned that in case of survival of severe brain injuries there is the need for long term hospitalization and rehabilitation too. We saw 5 cases with 12-25 weeks in hospital, average 22.4 weeks.

Long term consequences: 7 out of 117 patients have to cope with amputations. One attempt at replantation of a right upper arm had failed. 6 legs had to be amputated, 4 of them because of blood supply problems due to vessel lacerations. 2 legs were primarily subtotally amputated.

Social and occupational consequences for all patients are shown in Table 8.

Table 8 Social and Occupational Consequences (n=58, 1[illegible])

Group		I	II	III
n		19	25	14
Average time of absence from work or school	months	3.2	8.6	10.8
Average degree of permanent disability	per cent	9.5	12.4	27.1
Permanent unemployment	n	-	1	2
Inferior position	n	1	-	2
Retraining	n	-	1	2
Time loss in education	n	1	4	5
Worse examination scores	n	-	1	1
Total	n	2	7	12

It is clear that long term consequences are most serious in group III. Only 2 out of 14 patients did not suffer any disadvantage. The relatively long average time of absence from work or school in group II may be explained by the long rehabilitation for knee-joint ligament repairs and reconstructions.

Apart from the social disgrace 57% of group III patients have to deal with permanent pain, compared with 36% in group II and 10% in group I.

The injuries described and their consequences raise the question of effective protective measures.

PROTECTIVE MEASURES

As a result of the answers to 59 questionnaires the following frequency of the wearing of helmets and leather clothing was established: Table 9.

Table 9 Frequency of Wearing Helmet and Leather clothing

	Motor-bicycle	Moped	Motorcycle
n	16	16	29
Helmet	2 (12.5%)	8 (50.0%)	25 (92.5%)
Leather-jacket	6 (18.8%)		14 (51.8%)
Leather-trousers	1 (3.1%)		4 (14.8%)
Leather-overall	-		4 (14.8%)

Nearly all motorcyclists used helmets, but far less motorbike-riders. Leather clothing for protection of lower extremity was worn by 30% of the motor-cyclists and only 3.1% of moped-riders.

The protective effects of the wearing of helmet are demonstrated in Table 10:

Table 10 Protective Quality of Helmet Wearing (n=52)

	No cranio-cerebral injury	Commotio	Contusio	Compressio
With helmet	23 (92.0%)	4 (11.5)	3 (8.6%)	-
Without helmet	15 (62,5%)	2 (8.4%)	1 (4.2%)	5 (20.8%)
Total	44	6	4	5

Helmet wearing does not only reduce the percentage of brain injuries but also helps to diminish the severity from high grade to low grade injuries.

Table 11 demonstrates the protective effect of leather clothing, note the reduced frequency of severe soft tissue damage.

Table 11 Protective Quality of Leather Clothing (Lower extremity)

Group	I	II	III
Leather trousers or overall worn	5 (55.6%)	3 (33.3%)	1 (11.1%)
No leather clothing worn	14 (28.5%)	22 (44.8%)	13 (26.5)

DISCUSSION AND CONCLUSIONS

The statements about the protective quality of wearing helmets and leather clothings made in this paper should be regarded with caution because of the low number of cases. Nevertheless, they correspond with the results of other authors. SUREN (7) and WERNER (9) found a distinct decrease in the severity of injuries among helmet wearers, mainly in obtuse angle and wide contact collisions. REICH (5) dissected 188 fatally injured moped-riders and found that about half of them would have survived had they been wearing helmets. These findings and the low number of moped-riders who wear helmets should result in a law being passed making the wearing of helmets obligatory for all motorbicycle-riders. This would probably reduce the problem of brain trauma.

The high incidence of leg injuries among motorbicycle-riders has already been described by many other authors (FELDKAMP, 3; SUREN, 7). This paper demonstrates that injuries of the lower extremity are not only common, but also cause major problems in medical, social and personal fields. The decrease in the severity of injury by wearing leather clothing has also been found by SUREN (7) and FELDKAMP (3), but there is a need for experimental studies in this field. It is necessary to publish the significant advantages of leather clothing, even more so because the low frequency of using shows lack of knowledge concerning the problems of leg injuries. Progress can be expected by the development of less enpensive safety clothings similar to that used in motorcycle racing.

Motor bicycle manufactures should be encouraged to produce vehicles that offer effective protection for their riders, similar to the two wheeled safety vehicles of BARTOL (2), TANEDA (8) and WESTCOTT (10). Emphasis should also be given to producing motor-vehicles designed to reduce the severity of injuries sustained by motorbicycle-riders involved in a collision.

The previous information and statistics, as presented from the surgeon's point of view, show clearly the problems associated with motor-bicycle accidents. It is the task of the physicians and technicians to work towards a solution.

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